Design of wire driving system for earthquake simulator

14R55022 Jeon Hyeong Seok

KAIST

Prof. Yukio Takeda

Department of Mechanical Sciences and Engineering

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Introduction-why do we need earthquake simulator

Fig.1 2011 Tōhoku earthquake [1]

There is so many earthquakes in not only Japan but all around the world.

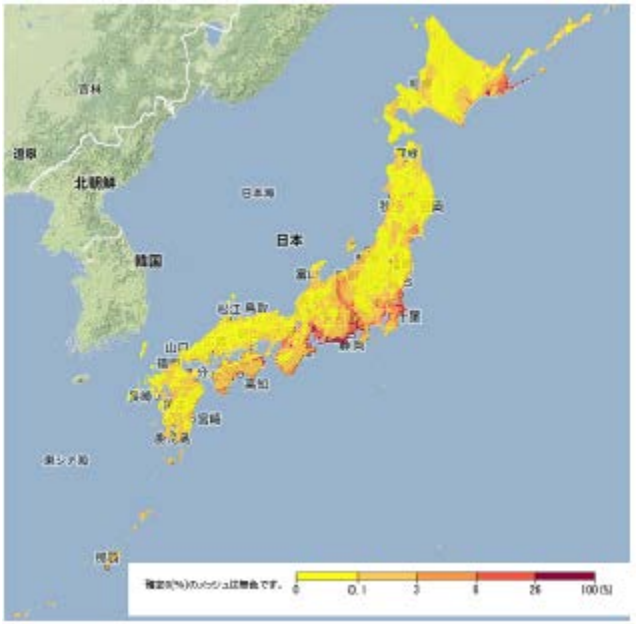

Fig.2 Earthquake prediction map [2]

Nowadays, there is no equipment to shake something directly so, constructor designs the building using only computer simulator.

We need earthquake simulator which can actually shake buildings

Introduction-current works in earthquake simulator area

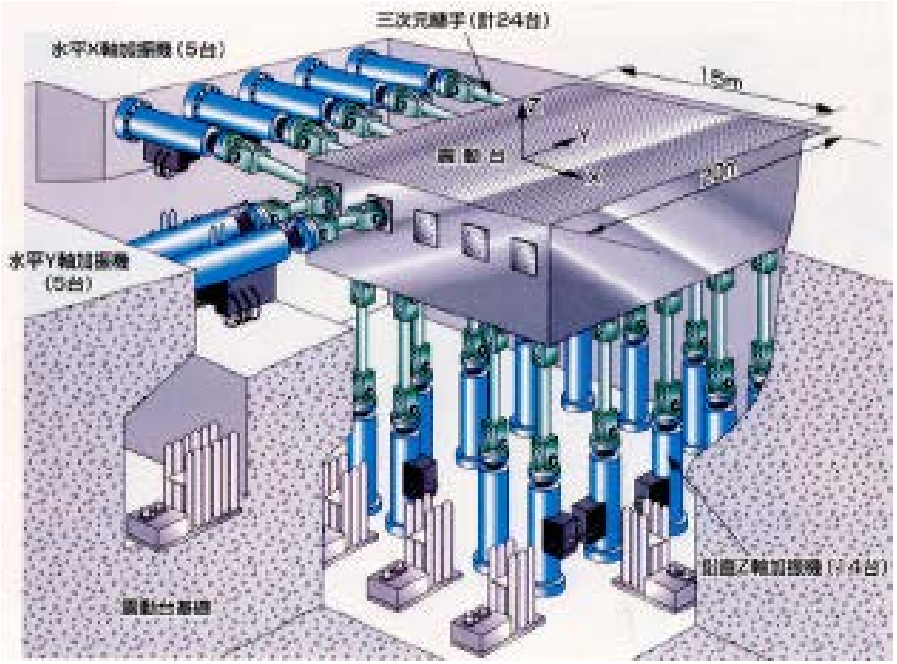

Fig. 3 E-defense [3]

Fig. 4 Earthquake TheVuton [4]

- This is moved by hydraulic motor. So, it's hard to control precisely.
- It is large scale equipment. So, we can't use easily.
- It is expensive and hard to move.
- It has low acceleration and it's durability is too low.

We develop wire-driving earthquake simulator with floating system using air pressure

Prototype

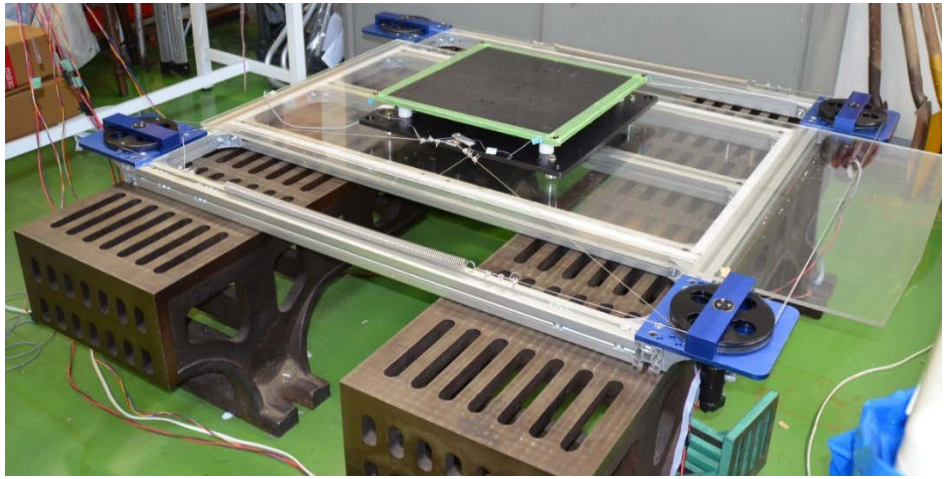

Fig. 5 General view of our prototype

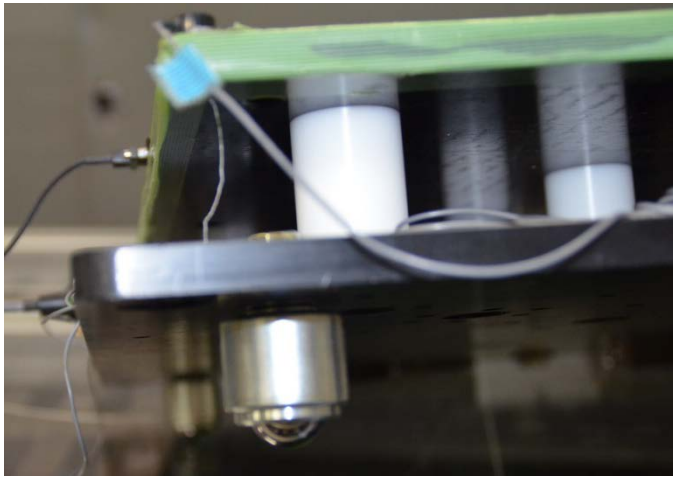

Fig. 6 Driving part of our prototype

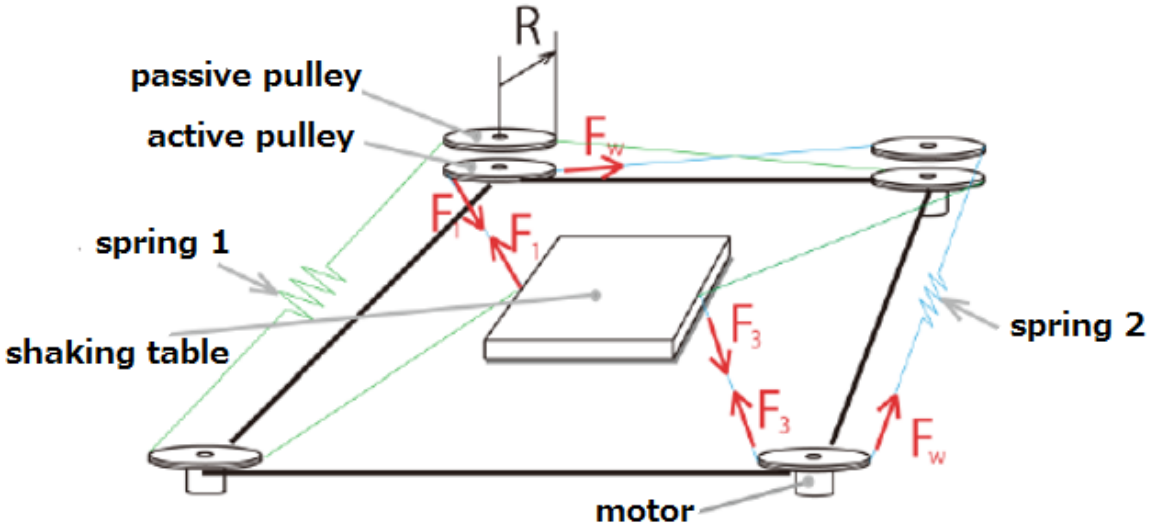

Fig. 7 Wiring system of our prototype

Experiment

Experiment 1 : sine wave motion into 2 directions (x direction, y direction)
Experiment 2 : circular motion

Fig. 8 3-dimensional position sensor(optotrak)

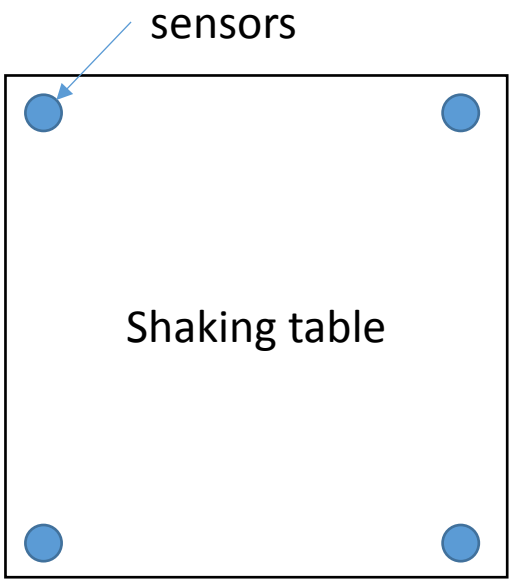

Fig. 9 position of sensors

We used Optotrak to detect 3-dimensional position of shaking table.

Experiment result-sine wave motion(from my tutor)

X direction sine wave motion

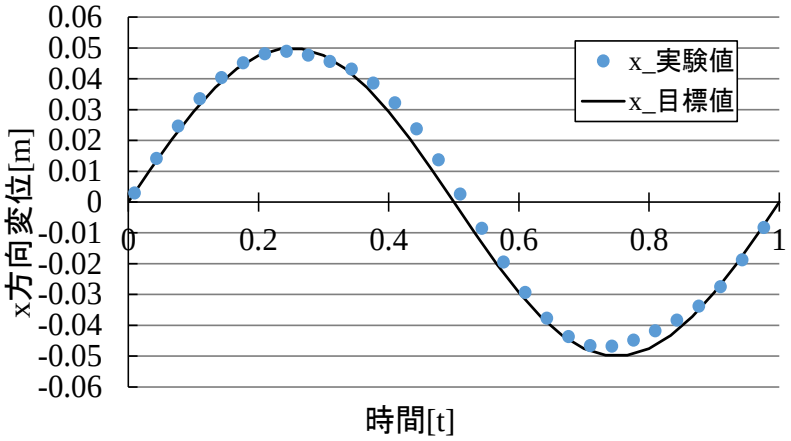

Fig. 10 amplitude:0.05m, frequency:1Hz

Y direction sine wave motion

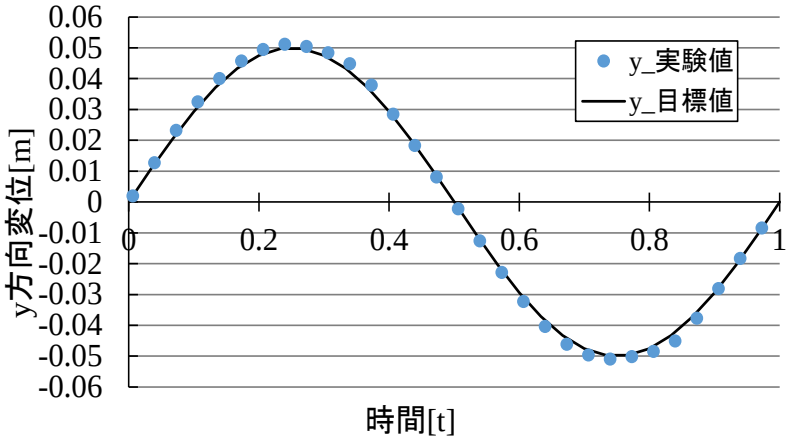

Fig. 12 amplitude:0.05m, frequency:1Hz

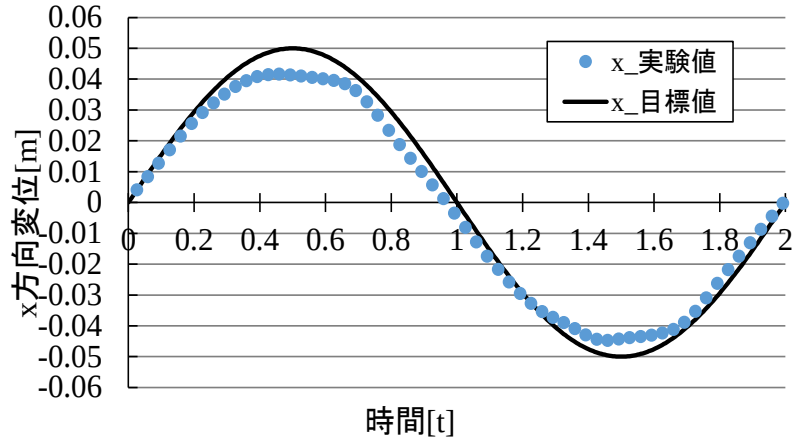

Fig. 11 amplitude:0.05m, frequency: 0.5Hz

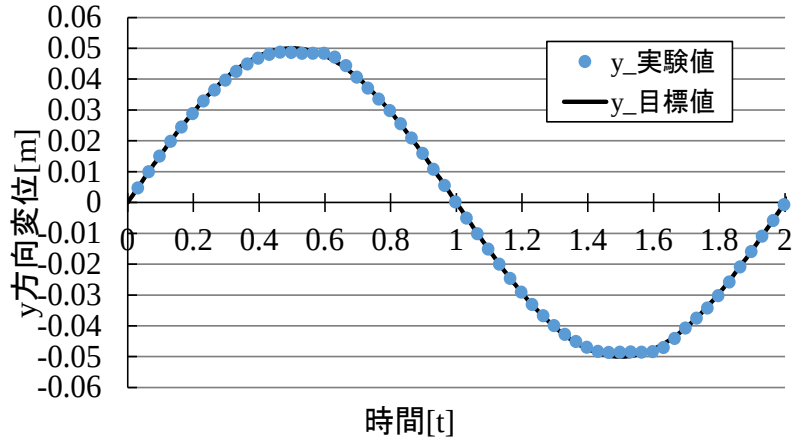

Fig. 13 amplitude:0.05m, frequency: 0.5Hz

Experiment result-circular motion(from my tutor)

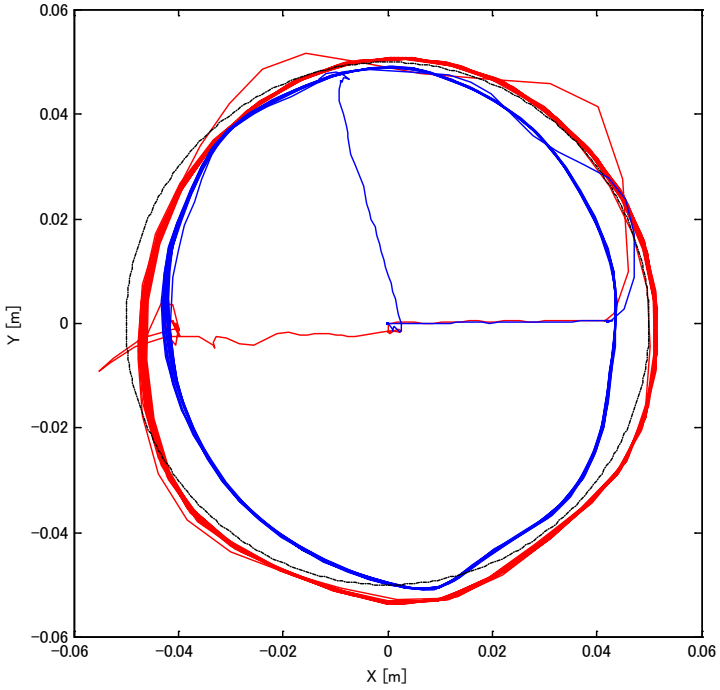

Fig. 14 radius: 0.05m, red: 1Hz, blue:0.5Hz

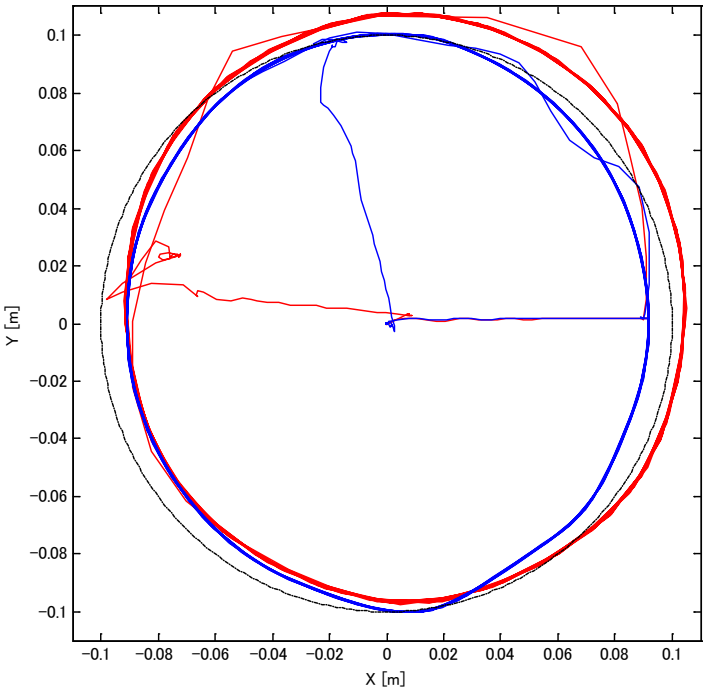

Fig. 15 radius: 0.1m, red: 1Hz, blue:0.5Hz

My life in Japan

Reference

[1] Fukushima Prefecture web site，https://www.pref.fukushima.lg.jp/

[2] Japan Seismic Hazard zinformation Station, http://www.j-shis.bosai.go.jp/en/

[3]小川　信行，E-ディフェンスの挑戦ー建設から活用へー

[4]Hakusan corporation，http://www.hakusan.co.jp/english/company/